

# Ground Level Ozone in the Great Smoky National Park

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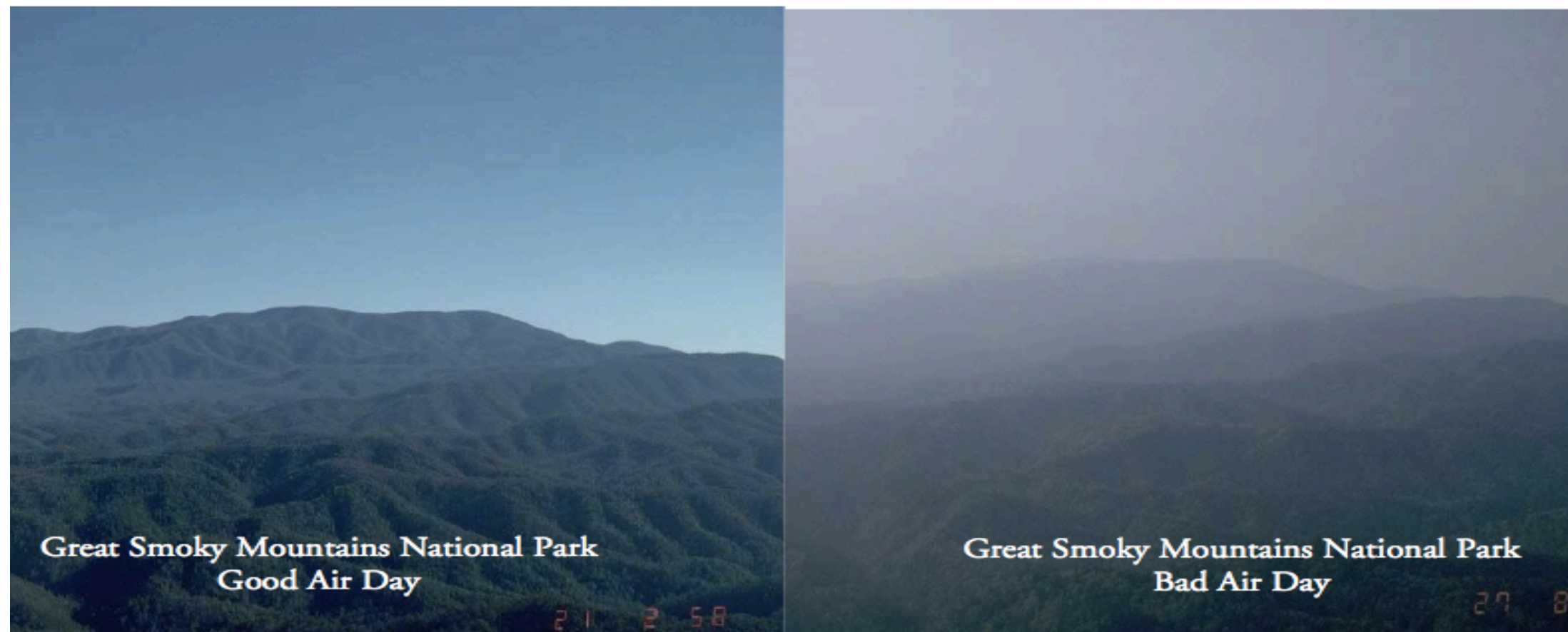
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## Introduction

The purpose of this research project was to investigate the amount of surface ozone,  $O_3$ , in the southern Appalachian Mountains or more specifically the Great Smoky National Park. While  $O_3$  amounts fluctuate daily during the summer, there is variation at different altitudes. The increased  $O_3$  levels in the summer affect hikers, workers and visitors to the park. Also, the  $O_3$  has a toxic effect on native plants. 27 years ago the first monitoring station was established at the higher elevations. Currently there are five stations measuring weather parameters and  $O_3$ .

## Background



The Great Smoky National Park is the most visited national park in the U.S. Nine million visitors drive through the park yearly. In its 500,000 acres it has 16 mountain peaks over 6000 feet (1829 Meters), 2115 miles of streams, 1400 flowering plants, 200 bird species, and 50 kinds of mammals. The Great Smokies were named for the blue haze seen throughout the valleys. The name originated with the Cherokees. Its original name was "Shaconage", Place of Blue Smoke. Mountain haze can be formed by the emissions of naturally occurring (biogenic) hydrocarbons from the trees. This haze can be created by manmade (anthropogenic) hydrocarbons also. Ozone is produced from the reactions of hydrocarbons and nitrogen oxides in the presence of sunlight. Scientists have been studying the effect of ozone on the deciduous and conifer trees and native plants of the Great Smoky National Park. Air pollution from the Southeast, Midwest and Gulf states travels and stagnates in the Great Smokies.



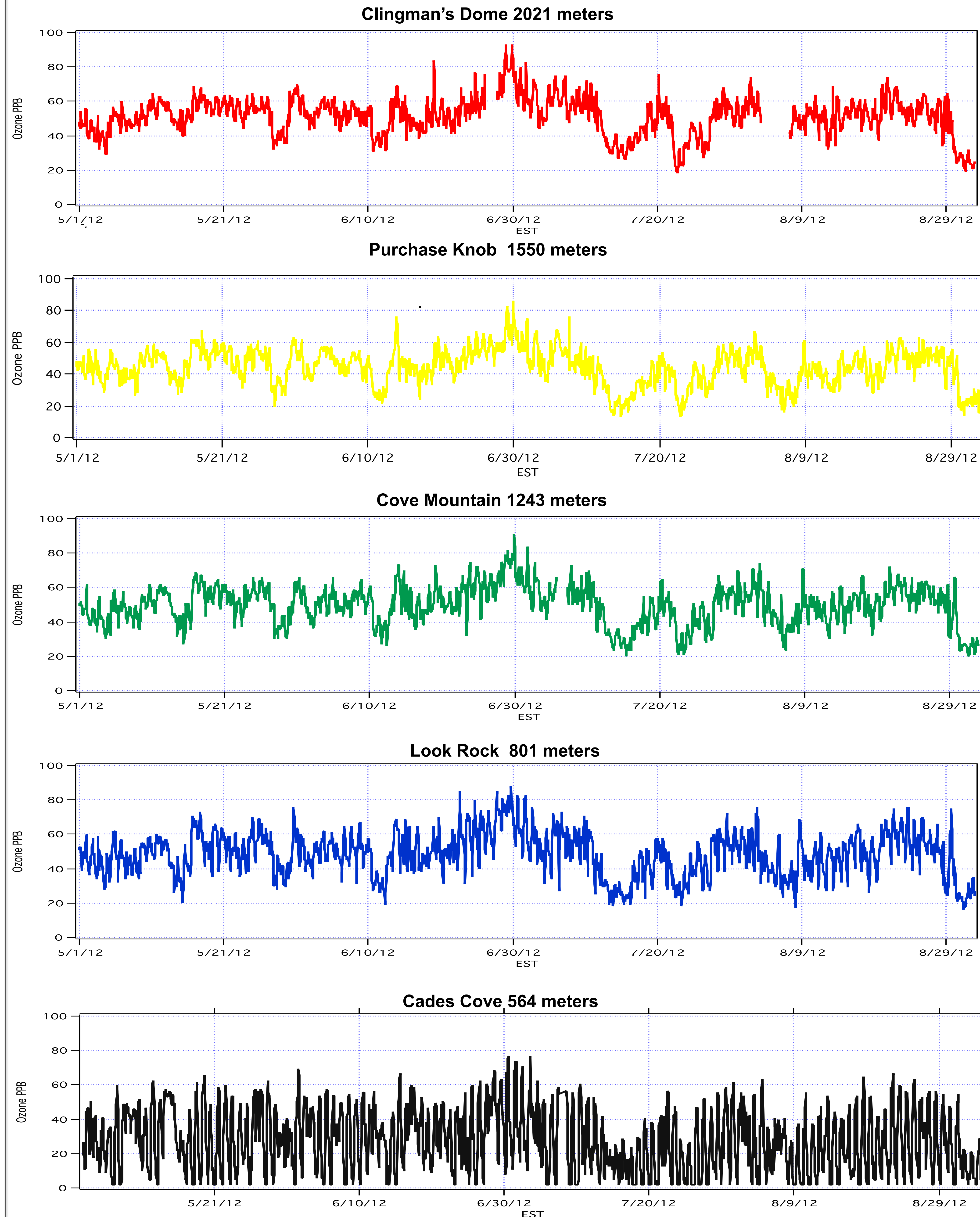
Many plants and trees show the effect of increased  $O_3$ . There are 85 plants in the Smokies endangered by increased levels of  $O_3$ . Ozone amounts can increase in the summer when there is an increased amount of sunlight and heat. This coincides with plant growth in forests and on farms. While not all plants are affected many are. In areas where there is increased  $O_3$  there is documented decrease in tree and agricultural production.

## Great Smoky National Park Location



## Data

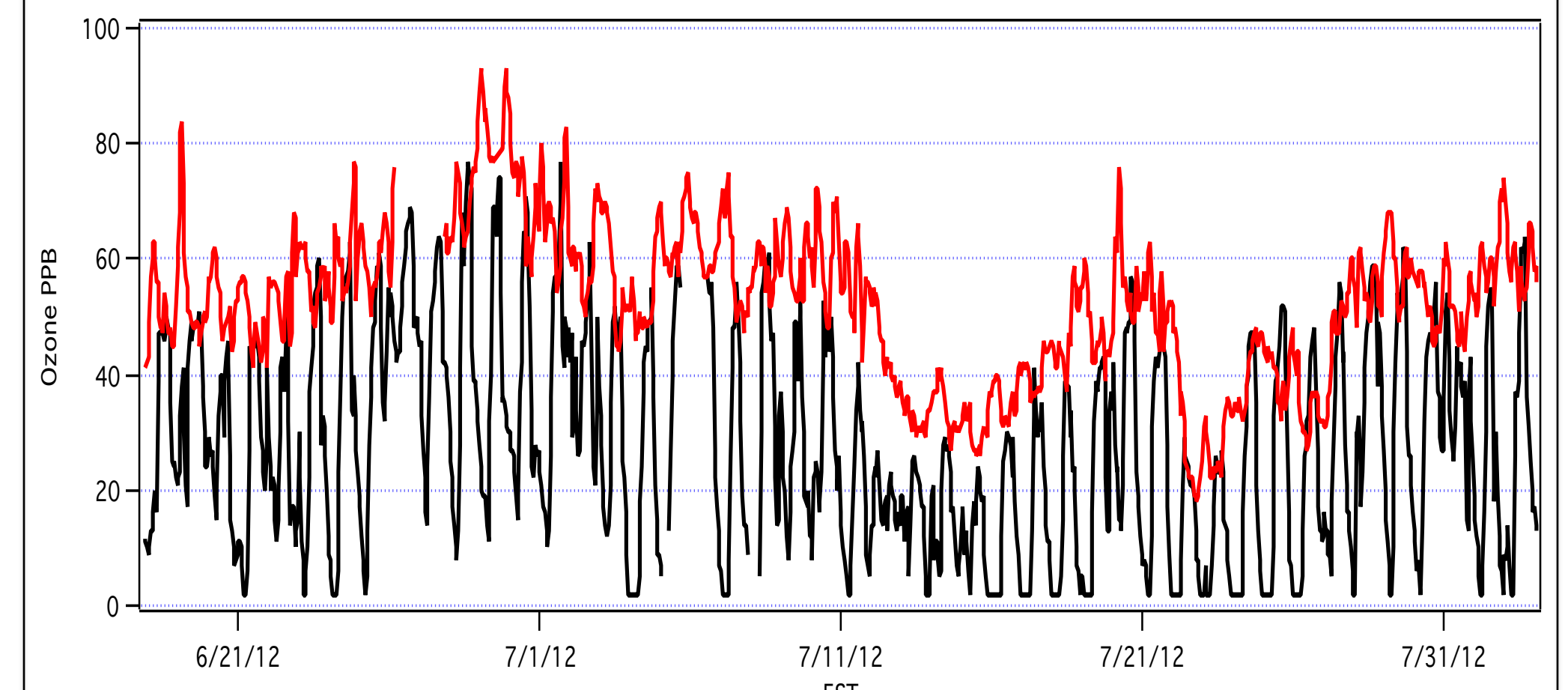
The graphs show the ozone fluctuation at specific sites at ozone monitoring stations throughout the Great Smoky National Park.



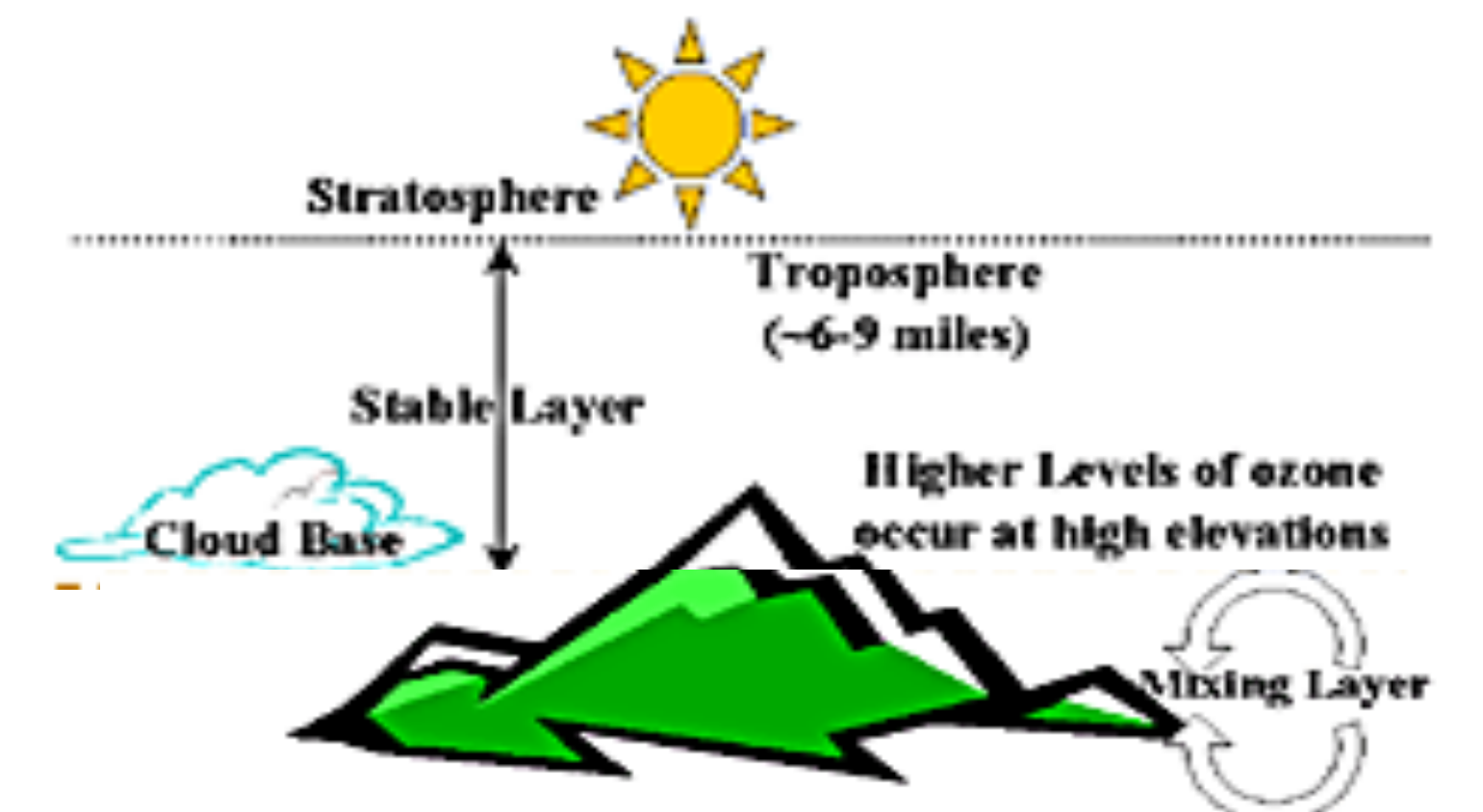
## Elevation Comparison

Elevation comparisons for ozone for Clingman's Dome and Cades Cove in the Great Smoky National Park

2021 meters (red) vs. 564 meters (black)



The lines on the graph demonstrate hourly fluctuations of ozone levels. At the lower elevation of Cades Cove (black) you see expected changes of lower ozone levels late at night and higher levels during daylight hours. At the higher elevations while there a fluctuation of ozone levels, the base level stays at an elevated amount. This can be caused by less vertical mixing of air leading to higher background concentrations of ozone. It is this constant exposure to higher amounts of ozone that is detrimental to plant growth and human health.



Ozone is a secondary pollutant formed through a series of photochemical reactions involving oxides of nitrogen ( $NO_x$ ) and volatile organic compounds (VOCs.) Major sources of anthropogenic VOCs include automobile emissions, gas transfers, burned coal or wood, and industrial use of paint solvents, degreasing agents and cleaning fluids. Sources of  $NO_x$  include fuel combustion in automobiles and power plants and processes used in chemical plants.

## Acknowledgements

This work was supported by the Long- Term Engagement in Authentic Research with NASA (LEARN) project with funding provided through NASA SMD EPOESS grant.

## References

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